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EXPERIMENTS UPON THE INFLUENCE OF THE MINERAL CONSTITUENTS OF THE BODY UPON IMMUNITY FROM INFECTIVE DISEASES.

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One of the most striking points in regard to infective diseases is the degree in which animals resist their attacks or succumb to them. The direction in which an explanation of this phenomenon is at present chiefly sought is the powers of living cells to destroy intruding microbes, or of albuminous substances in the blood or lymph to destroy the invading microbes and to neutralise the action of their poisonous products. The differences which exist between albuminous substances are probably due in part to their different molecular weight, but we also know that the reactions of many albuminous bodies are greatly modified by the various proportions of inorganic constituents, such as soda, potash, or lime, in the fluid which dissolves them, or from which they may be precipitated by heat or by various reagents.

It has been found by Gilbert and Lawes that the ashes of different animals are not alike in their composition, and it seems therefore possible that a difference in the mineral ingredients of an animal's body may be one of the factors in determining the amount of resistance it may present to infective diseases.

In a research made by one of us (Brunton), along with Cash, it was found that not only was the effect of barium on the frog's muscle counteracted by potash, but by feeding an animal for some time with potash the poisonous action of barium could be to a considerable extent counteracted, the potash appearing to have accumulated in the body to such an extent as partially to antagonise the barium, which was afterwards administered. By treating an animal with perchloride of mercury, Cash succeeded in conferring immunity against anthrax, so that when subsequently inoculated it remained alive, while a control animal died in a few days. These facts seemed to render it worth while to undertake a research into the effect of the administration of potash, soda, or calcium in increasing or diminishing the resisting power of animals to anthrax. The effect of sodium bicarbonate has already been tested by Fodor, but his experiments were directed to the effect of it upon the alkalinity of the blood, and not to the effect of the base as compared with other alkalies or alkaline earths. His experiments seemed to show that sodium bicarbonate tended to confer immunity, for of nineteen rabbits treated by injection of its solution and then inoculated with anthrax, seven survived, three developed the typical disease, while in the remaining nine the cause of death was uncertain. M. Chor* has performed similar experiments, but with different results, for he found that animals thus treated not only did not recover from the disease, but died almost uniformly before control animals inoculated without previous preparation. He found, also, that by using the alkali, as recommended by Fodor, death might ensue from this alone without subsequent inoculation. These experiments seem to show that the alkalinity of the blood is not the important factor in resistance, and it is possible that the contradictory results of these observers may have been partly due to the nature of the food which the animals received before and during the experiments. But in all probability the soda salts were kept rather in excess in the animal by the administration of the drug, and we may regard them as indicating that an increased proportion of sodium does not tend, to any great extent at least, to confer immunity, although the increased resistance observed by Fodor might be explained on this hypothesis as well as on that of increased alkalinity.

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* *Annales de l'Institut Pasteur*, May, 1891.

In the present paper we intend to consider the effect of potash, reserving for another communication the effect of lime, magnesium, and alumina, as our experiments on them are not yet concluded. In February of this year we commenced the research by feeding a number of guinea-pigs with bran containing potassium chloride (30 to 60 grams per kilogram). They took this food readily, and were fed on it and on cabbage for periods varying from three weeks to three months. They all maintained excellent health and in no case lost weight. The animals were then inoculated with anthrax, controls being also inoculated with the same virus. We think our method of feeding the animals preferable to that adopted by MM. Fodor and Chor, as in every case the animals remained in perfect health till inoculated. The results were as follows:—

(*a*) Six guinea-pigs, fed with potassium chloride for periods varying from three to six weeks; three control animals fed in the ordinary manner. Inoculation with a virus (proved to be fatal to rabbits in three days) caused development of anthrax in all the animals, so that all died in from forty to forty-eight hours.

(*b*) Six guinea-pigs were fed with potassium chloride during two months; six control animals were fed in the usual way. Inoculation with a feebly virulent anthrax (Pasteur's second vaccine) proved fatal to all in from forty-four to seventy hours. Four of the prepared animals died before any of the controls.

(*c*) Two guinea-pigs, fed (with a short intermission) with potassium chloride for three months, and one control animal, were inoculated with the second vaccine anthrax. One of the prepared animals was moribund in forty-four hours, the other two being found dead next day. Typical cultures of anthrax were obtained from all the animals mentioned above.

The result of our experiments is that saturation of guinea-pigs with potassium chloride in no way confers immunity against anthrax—in fact, that in animals thus prepared death occurs more rapidly than in control animals. This result may be due either to a positive action of the potash itself or its having tended to cause elimination of other bases, such as sodium or calcium. We think it is just possible that if the food of Fodor's animals happened to contain a large proportion of potash salts, the comparative immunity produced in them by the injection of soda might be due, not to any positive action of the soda, but simply to its tending to displace a certain proportion of potassium from the body.

Our experiments upon the action of calcium, magnesium, and aluminium are now in progress, and we hope shortly to communicate the results of them.

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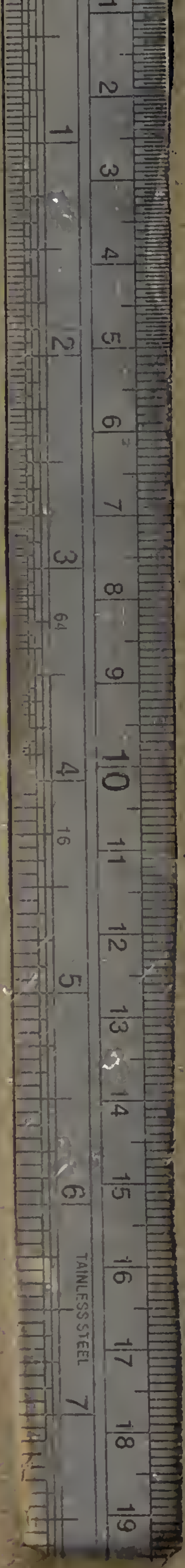
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